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PATENT SPECIFICATION

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(19)

(54) IMPROVEMENTS IN OR RELATING TO THE SECURING OF STRUCTURES TO TUBULAR METAL PILES UNDERWATER

(71) We, NOL OFFSHORE SERVICES (UK) LIMITED, a British Company, of 131—133 Holland Park Avenue, London W11 4UT (formerly of 4—9 Wood Street, London EC2V 7JY), do hereby declare the invention, for which we pray that a Patent may be granted us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to the securing of structures to tubular metal piles underwater.

It is the conventional practice where, for example, a base is to be fastened to the sea-bed by piles for the base to incorporate individual tubes which encircle the parts of the piles projecting above the sea-bed, and the tubes are then secured to the piles by any one of several methods including welding or grouting, or driving a pin diametrically through each pile and the surrounding tube. All of these methods are however extremely expensive by reason of the need to ship out divers and the required special apparatus for underwater work and the lengthy work necessary on site.

According to the present invention there is provided a method of securing to tubular metal piles a structure incorporating a plurality of tubes through which the respective piles project, which method comprises locally deforming each pile outwardly into tightly swaged or welded engagement with the encircling tube by detonation of an explosive charge within the pile.

It will be understood that the only work required of the diver in an underwater operation according to the invention is to ensure that the explosive charge is correctly positioned and located. The required shape and size of the explosive charge are all determined beforehand.

The pile and tube may initially both be cylindrical at the location of the intended explosion, so that the explosion deforms both the pile and the tube outward locally, or alternatively the tube may initially be outwardly deformed as by swaging so that the explosion deforms principally the pile, expanding it locally into swaged or welded engagement with the tube.

The invention will now be described in more detail with reference by way of example to the accompanying diagrammatic drawings in which:

Figures 1 and 2 are diagrammatic sectional views illustrating respectively the shapes of the tube and pile, in one method according to the invention, respectively before and after the detonation of the explosive charge.

Referring first to Figure 1, the reference numeral 10 indicates a metal frame structure which is to be fixed to the sea-bed by securing the structure to tubular steel piles driven into the sea-bed 11. One such pile is shown at 12.

The structure 10 incorporates a number of vertical pile guide tubes 13 and operates, during its installation, as a template for locating the piles in their correct positions whilst they are being driven. To assist in guiding the leading ends of the piles into the tubes, the upper ends of the tubes are belled outward. Each pile is thus lowered through the corresponding tube 13 and hammered into the sea-bed. When the pile has been driven in, its upper end is left projecting just above the top edge of the tube 13, the pile being cut off at this level if necessary. Each of the guide tubes has intermediate its ends a swaged-out portion as shown at 14 and to secure the structure to the piles a shaped explosive charge 15 suspended on a line 16 is lowered into the pile to a position level with portion 14 of the tube, is located in that position and is then detonated. The explosion deforms the pile locally outwards into swaged or welded engagement with the portion 14 of the tube, so that the structure is located against upward or downward movement relative to the pile.

The shape and size of the charge are selected according to materials used, the

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depth and density of the water, whether a swaged interference fit or a welded interface fit is requred between the pile and the guide tube, and other relevant factors.

If desired, the initial swaging of the guide tubes may be omitted, and in that case the tube is made from a metal having a sufficient degree of malleability to enable it to be deformed outward, without fracturing, by the explosion, so that again a swaged interference fit or welded interface fit is obtained between the tube and pile.

WHAT WE CLAIM IS:—

1. A method of securing to tubular metal piles a structure incorporating a plurality of tubes through which the respective piles project, which method comprises locally deforming each pile outwardly into tightly swaged or welded engagement with the encircling tube by detonation of an explosive charge within the pile.

2. A method as claimed in claim 1, wherein each tube is initially of locally increased diameter at the location of the explosive charge.

3. A method of securing to tubular metal piles a structure incorporating a plurality of tubes through which the respective piles project, which method is substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.

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1 SHEET This drawing is a reproduction of the Original on a reduced scale

FIG. 1

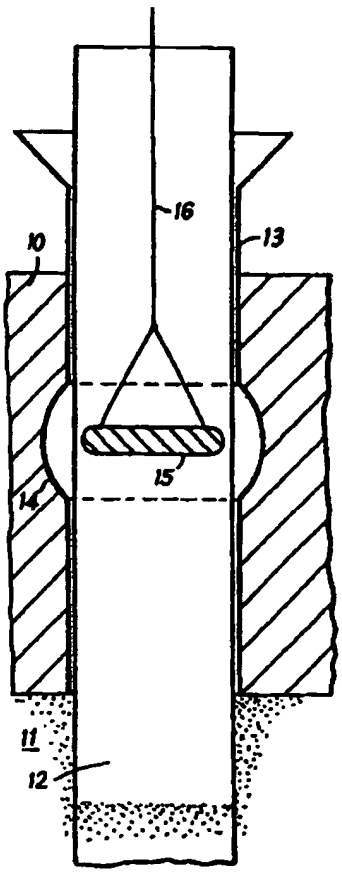
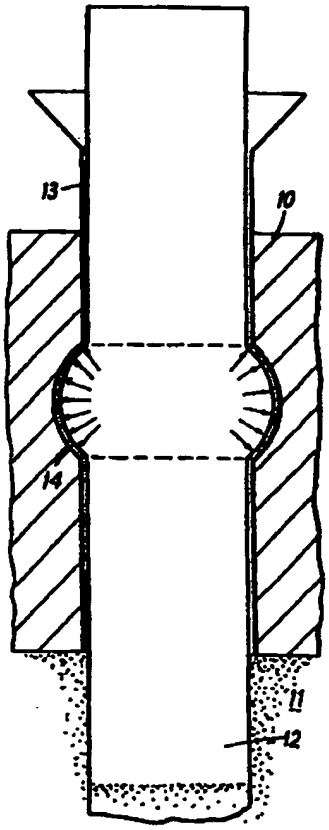


FIG. 2



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